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6/ Priority Doc.
E. Willis
4-24-02

I HEREBY CERTIFY that annexed hereto is a true copy of documents filed in connection with the following patent application:

Application No.	S990607
Date of Filing	16 July, 1999
Applicant	SUPARULES LIMITED, an Irish Company of 9 Technological Park, Castletroy, Limerick, Ireland.

Dated this 8th day of February, 2000.

An officer authorised by the
Controller of Patents, Designs and Trademarks.
pp

S990607

FORM NO. 1

REQUEST FOR THE GRANT OF A PATENT
PATENTS ACT, 1992

The Applicant named herein hereby request

__ the grant of a patent under Part II of the Act

X the grant of a short-term patent under Part III of the Act

on the basis of the information furnished hereunder.

1. **APPLICANT**

Name	**Suparules Limited**
Address	**9 Technological Park, Castleroy, Limerick, Ireland**
Description/Nationality	**An Irish Company**

2. **TITLE OF INVENTION**

"Electrical Energy Meter"

3. **DECLARATION OF PRIORITY ON BASIS OF PREVIOUSLY FILED APPLICATION FOR SAME INVENTION (SECTIONS 25 & 26)**

Previous filing date	Country in or for which filed	Filing No.

4. **IDENTIFICATION OF INVENTOR(S)**
Name(s) of person(s) believed by Applicant(s) to be the inventor(s)
(To Follow)

Address
(To Follow)

5. **STATEMENT OF RIGHT TO BE GRANTED A PATENT (SECTION 17(2)(B))**

(To Follow)

Contd./...

6. **ITEMS ACCOMPANYING THIS REQUEST - TICK AS APPROPRIATE**

(i) X prescribed filing fee (£50.00)

(ii) _ specification containing a description and claims

X specification containing a description only

X Drawings referred to in description or claims

(iii) _ An abstract

(iv) _ Copy of previous application(s) whose priority is claimed

(v) _ Translation of previous application whose priority is claimed

(vi) _ Authorisation of Agent (this may be given at 8 below if this Request is signed by the Applicant(s))

DIVISIONAL APPLICATION

The following information is applicable to the present application which is made under Section 24

Earlier Application No:
Filing Date:

8. **AGENT**

The following is authorised to act as agent in all proceedings connected with the obtaining of a Patent to which this request relates and in relation to any patent granted -

Name	**Address**
F. R. KELLY & CO.	at their address as recorded for the time being in the Register of Patent Agents

9. **ADDRESS FOR SERVICE (IF DIFFERENT FROM THAT AT 8)**

SUPARULES LIMITED
F. R. KELLY & CO.

By: _____
EXECUTIVE

Date: July 16, 1999

APPLICATION No S990607

ELECTRICAL ENERGY METER

This invention relates to an electrical energy meter.

Standard electro-mechanical electrical energy meters have some or all of the following disadvantages.

They all consume a significant amount of power to operate. The IEC standard for class II meters is <2 watts. This power consumption amounts to between .25% to .5% of all power consumed. Losses due to metering are therefore substantial.

They have inertia problems when starting; therefore they must have a certain amount of power being drawn before they start to register.

They can only be installed by skilled personnel, and their installation is time-consuming. Electro-mechanical meters need to be fixed firmly to a flat surface in an upright position. In territories such as the former Soviet Union when metering is being installed in volume for the first time, the cost of installation of the electro-mechanical meters is high.

~~It is an object of the invention~~ to provide a low cost, low power meter which is quick and easy to install and which may, if desired, be retro-fitted to existing mains installations.

According to the present invention there is provided an electrical energy meter comprising an electrically insulating housing for securing relative to least two

mains cables each having a conductive core surrounded by a sheath of insulating material, the housing including respective electrical contact means for piercing the insulating sheath of each cable to make contact with the core, sensing means for providing an output corresponding to the current flowing in at least one of the cables, and circuit means for calculating and displaying electrical energy as a function of the voltage across the contact means and the output of the sensing means.

An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of a meter according to the invention with the front plate removed;

Fig. 2 is a top plan view of the front plate of the meter of Fig. 1;

Fig. 3 is a horizontal cross-section through the meter; and

Fig. 4 illustrates a security device for the meter.

In the following description, expressions of orientation are used for convenience only and are not intended to limit the orientation of the meter in use.

Referring to the drawings, an electrical energy meter is shown for measuring and displaying the amount of energy supplied by a pair of mains live and neutral

cables 22, 24 respectively, each having an inner conductive core surrounded by an outer sheath of insulating material.

The meter comprises a housing 10 formed in two parts, herein referred to as a back plate 12 and a front plate 14, moulded from an electrically insulating plastics material. The back plate 12 is a solid block having a flat rear surface 16 and a shaped front surface 18. The back plate 12 has two holes 20 to receive fixing devices such as screws or bolts (not shown) which allow the back plate to be fastened with its rear surface 16 flat against a wall or other supporting surface (also not shown) behind the mains cables 22, 24. The latter are, in use, placed across the front surface 18 of the back plate 12 such that each lies in and along a respective one of a pair of parallel vertical guide channels 26, 28 in the surface 18. The front surface 18 also has a pair of recesses 30 disposed closely one on each side of the upper end of the channel 28 containing the neutral cable 24.

The front plate 14, which is hollow to contain a printed circuit board 32 and an LCD counter 34 to be described, has a shaped rear surface 36 and a substantially flat front surface 38. The rear surface 36 has a pair of parallel vertical ribs 40, 42 and a pair of parallel projections 44 disposed closely one on each side of the upper part of the rib 42. The ribs 40, 42 and projections 44 on the rear surface 36 are shaped and located such that they are substantially complementary to the channels 26, 28 and recesses 30 in the front surface 18 of the back plate 12.

In use, when the back plate 12 has been fixed to a wall or other support surface with the cables 22, 24 disposed in the channels 26, 28 as described, the front plate 14 is offered to the back plate 12 with the ribs 40, 42 in register with the channels 26, 28 respectively and the projections 44 in register with respective recesses 30, and the front plate is then pushed towards the back plate such that the ribs enter the channels and the projections enter the recesses. The front plate 14 is clamped to the back plate 12 in this position by means of four bolts 46 which pass through the front plate and engage respective screw-threaded inserts 48 embedded in the back plate, the bolts 46 being tightened until the rear surface 36 of the front plate comes to abut against the front surface 18 of the back plate.

As seen in Fig. 3, the width of each channel 26, 28 is substantially the same as the diameter of the respective cable 22 or 24, while the depth of each rib 40, 42 is less than the depth of the corresponding channel 26, 28 by a distance substantially the same as the diameter of the respective cable 22 or 24. Thus, when the two plates 12, 14 are clamped together as aforesaid, each cable 22, 24 is snugly accommodated in a respective vertical bore 50 of square cross-section in the housing 10.

Each rib 40, 42 has a respective electrical contact 52, Fig. 2, securely embedded therein, each contact having a pointed forward end 54 projecting centrally from the free end of the rib. Thus, when the front and back

plates 12, 14 are clamped together as aforesaid, each forward end 54 of a contact 52 automatically pierces the insulating sheath of the corresponding cable 22 or 24 to establish electrical contact with the conductive core. In use, therefore, the contacts 52 tap the instantaneous voltage across the cables 22, 24.

In addition to the contacts 52 for tapping the voltage across the cables 22 and 24, the front plate 14 also contains one or more coils for sensing, by induction, the instantaneous current in the neutral cable 24 and providing an output signal corresponding to such current. In the present embodiment such sensing is effected by a series of coils 56 embedded in and behind the projections 44 so as to surround the cable 24 on three sides. Such an arrangement of coils may be as described in Irish Patent Application No. S990061, although other arrangements can be used.

The voltage tapped by the contacts 52 and the output of the current sensing coils 56 are connected to an energy-calculating circuit (not shown) mounted on the printed circuit board 32. Such circuit may be of conventional design and is arranged to calculate, in known manner from the tapped voltage and the sensed current, the electrical energy in KWhrs supplied by the cables 22, 24. The circuit drives an LED counter 34 which displays the calculated result.

In order to prevent tampering with the meter, the head 46a, Fig. 4, of at least one of the bolts 46 projects from the front surface 38 of the front plate 14 and has

a cross bore 58. Just below each such bolt there is a respective tab 60 projecting from and securely embedded in the front surface 38, each tab having a hole 62. A wire 64 passing through the bore 58 and hole 62 and sealed at 66 prevents the bolt 46 from being turned sufficiently to remove the front plate 14 from the back plate 12.

In the arrangement of Irish Patent Application No. S990061, a number of Rogowski coils are connected in series around the circumference of a circle, with substantailly equal spacing between successive coils. A gap between two of the coils allows the current-carrying conductor to be introduced, such that the current-carrying conductor is partially surrounded by the circular array of coils. Current through the conductor generates a voltage through the series of coils, which is only minimally affected by interference external from external voltage sources. In a preferred embodiment, the coils are aranged in a double circle, enabling even higher signal-to-noise ratios to be achieved.

Fig. 5 shows a simple embodiment of such a coil arrangement in greater detail. In Fig. 5 one can see a portion of the back plate 12 and front plate 14 in the vicinity of rib 42, projections 44 , and neutral cable 24. It can be seen that neutral cable 24 is pierced by forward end 54 of contact 52, which is connected via a voltage take-off conductor 60 to the PCB (not shown). The voltage between the live and neutral conductors is used to power the PCB measurement circuitry and the LCD display.

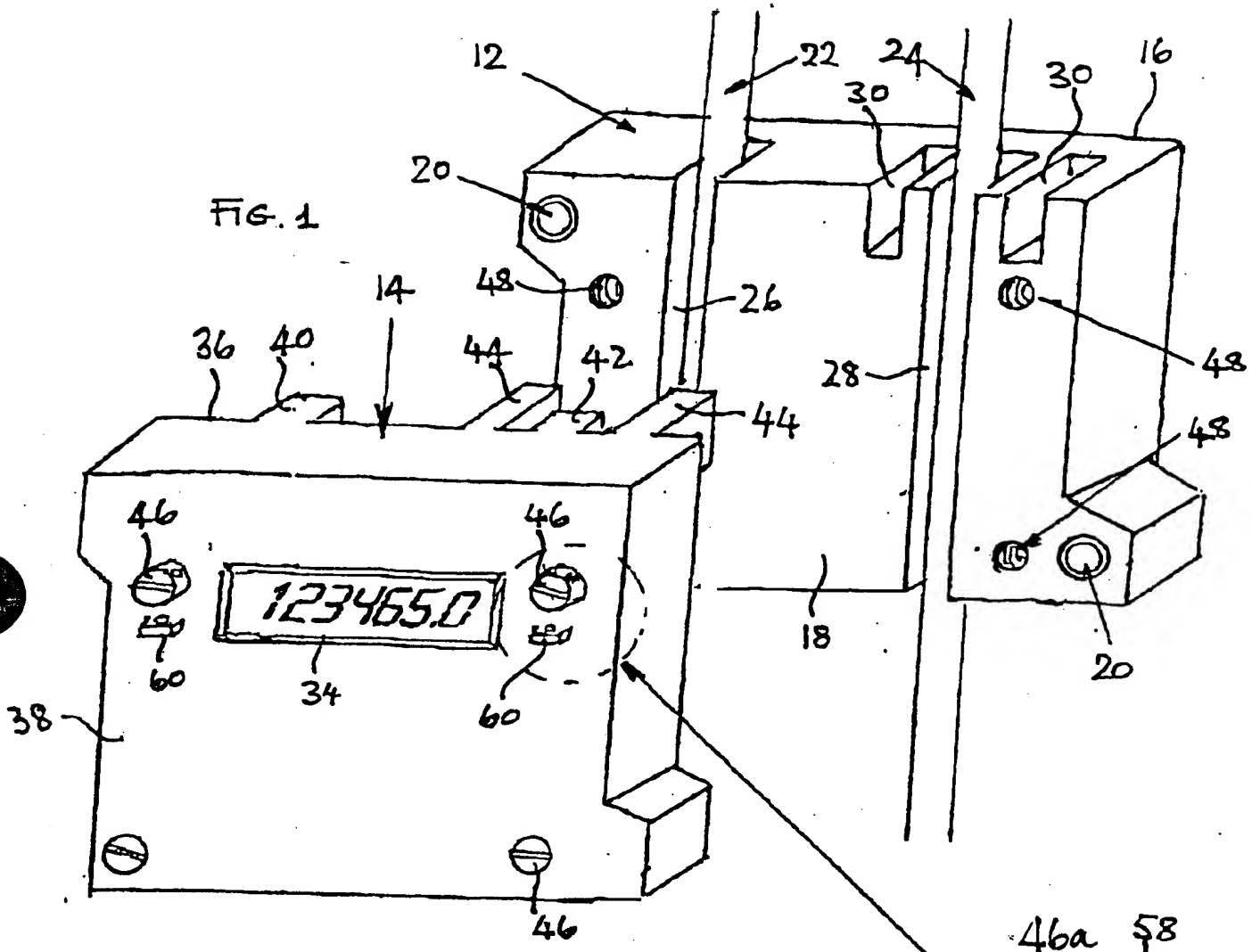
Five coils 56 are arranged around the circumference of a circle, and are connected in series. A gap between the two uppermost (as seen in Fig. 5) coils 56 admits neutral cable 24. The voltage generated in the series of coils is carried via a pair of conductors 58 to the PCB where the current within the neutral conductor is determined from the calibration of the coils 56.

The greater the number of equally spaced coils 56 and hence the smaller the gap between coils, the more sensitive the device will be, when the coil arrangement of Irish Patent Application No. S990061 is used. Advantages of the meter described above are that it may be manufactured at low cost and is easy and quick to install to existing mains systems. It can be designed to use <40mwatts to power itself, being less than 2% of the power required by existing analog meters. It does not suffer from inertia and will register power at 50 times lower levels than existing meters.

Although the foregoing has described an embodiment where the meter is designed for use with a single pair of live and neutral cables, the invention is applicable to other mains systems, for example with three phase and one neutral cable.

The invention is not limited to the embodiments described herein which may be modified or varied without departing from the scope of the invention.

FIG. 1



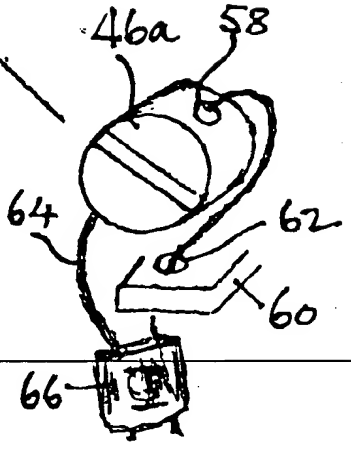


FIG. 4

FIG. 3

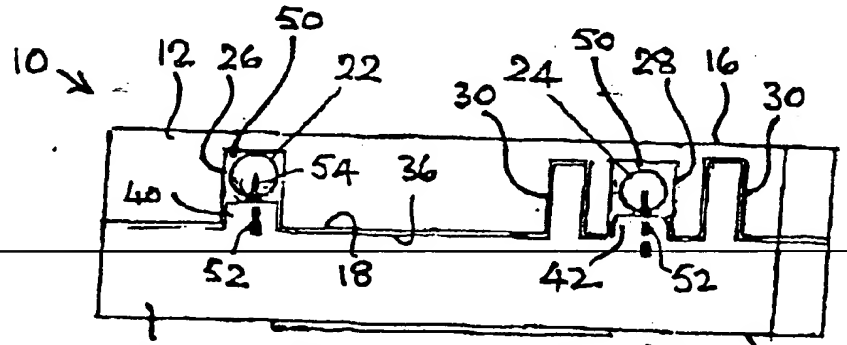


FIG. 2

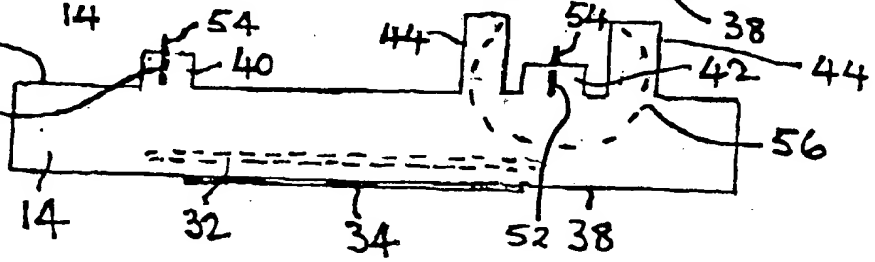


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FIG. 5